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EXAMINER

KIELIN, ERIK J

ART UNIT PAPER NUMBER

2813

DATE MAILED: 11/21/2002

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Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/492,557

Applicant(s)

ANTHONY, THOMAS C. *th*

Examiner

Erik Kielin

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The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 30 September 2002.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 34-44 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 34-44 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_ 6) ☐ Other: \_\_\_\_\_

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## DETAILED ACTION

### *Continued Examination Under 37 CFR 1.114*

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 30 September 2002 has been entered.

### *Claim Rejections - 35 USC § 112*

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 43 and 44 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. The instant specification states at p. 12, beginning at line 17,

“In an alternative embodiment of a structure for stabilizing a magnetic memory cell 40, the structure 56 is a **hard ferromagnetic material** that is magnetized along the length of the conductor 20, a direction that is substantially perpendicular to the easy axis of the sense layer. In this alternative embodiment, the structure 56 **does not function as a keeper** but is instead a source of magnetic field for stabilizing the edge regions 157 and 158.” (Emphasis added.)

Accordingly the keeper structure cannot be a hard ferromagnetic material according to Applicant and the claims are not enabled by Applicant's own admission.

*Claim Rejections - 35 USC § 102*

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) do not apply to the examination of this application as the application being examined was not (1) filed on or after November 29, 2000, or (2) voluntarily published under 35 U.S.C. 122(b). Therefore, this application is examined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

5. Claims 34-36, 38, 40, 41, 43, and 44 are rejected under 35 U.S.C. 102(b) as being anticipated by US 5,748,524 (**Chen et al.**) considered with the text Introduction to the Theory of Ferromagnetism by **Aharoni**, Clarendon Press: Oxford, 1996, p. 16.

Regarding claims 34, 40, 41, 43 and 44, **Chen** discloses a magnetic memory comprising a memory cell comprising a sense layer/reference layer 21/23, 41/43, tunnel barrier 22, 42 (instant claim 40) and a stabilizing (i.e. keeper) structure 30, 55 which is formed of a soft or hard ferromagnetic material (col. 4, lines 58-63; col. 6, lines 5-10) formed adjacent to the sense layer (instant claim 41) with an easy axis --in the case of the soft magnetic material-- or a magnetized axis --in the case of the hard magnetic material, as further limited by instant claims 43 and 44-- oriented perpendicular to the easy axis of the sense layer and accordingly parallel to the edge

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regions of the sense layer; a shape that provides flux closure: a path for magnetic flux transport between a pair of opposing edge regions of the sense layer (col. 4, lines 41-44); and prevents disruptions (e.g. demagnetization fields) to the magnetization state 11 in the sense layer. (See Figs. 5-8; columns 3-6.)

Exchange coupling between the keeper structure and the sense layer necessarily occurs because the end regions are pinned by the keeper structure. Note that “exchange” and “exchange energy” are defined in the text Introduction to the Theory of Ferromagnetism by **Aharoni**, Clarendon Press: Oxford, 1996, p. 16, to be the existence of a force for aligning the spins of unpaired electrons i.e. aligning the magnetic moments. Accordingly, the ferromagnetic coupling is necessarily an example of “exchange coupling” by definition of exchange and exchange energy.

Regarding claim 35, **Chen** shows that the flux closure path between the edge regions prevents overall magnetization in the sense layer from straying from parallel and antiparallel orientations with respect to the easy axis of the sense layer.

Regarding claim 36, the keeper structure 30, 55 has an easy axis which is substantially perpendicular to the easy axis of the sense layer, as noted above.

Regarding claim 38, the keeper structure is formed from a permeable ferromagnetic material (NiFe or NiFeCo; col. 2, lines 4-10). Note the instant specification at p. 11, 13-17 states that this is the material of the keeper structure.

6. Claims 34, 37 and 39 are rejected under 35 U.S.C. 102(e) as being anticipated by **Hurst et al.** (US 5,956,267).

**Hurst** discloses an MRAM array wherein each memory cell includes the sense layer / tunnel layer / reference layer stack, 70, (Fig. 8, column 6, lines 27-42); the stabilizing structure “keeper” (30 in Figs 6-8; in the trench in Figs. 9-13 but not labeled; column 5, lines 27-47) formed of a magnetically permeable ferromagnetic material which (1) has a U-shape (Figs. 9-13) which runs along the wordline and therefore along plural memory cells (Abstract); (2) has a shape and proximity to the sense layer that provides flux closure: a path for magnetic flux transport between a pair of opposing edge regions of each sense layer; (3) inherently prevents disruptions to the magnetization state in each sense layer by specifically “directing demagnetization fields away from the edge regions;” and (4) applies a magnetic field to a set of edge regions which is **perpendicularly oriented** to the easy axis of each sense layer **in the absence of an electric current flowing** through the wordline. (See especially Fig. 16 which shows the magnetic flux **only while current is flowing** through the wordline; column 7, lines 6-15.)

As further evidence that the easy axis of the keeper structure in **Hurst** is along the length direction of the keeper structure and accordingly perpendicular to the easy axis of the sense layer, see Applicant’s specification, page 7, 1st paragraph. This paragraph indicates that the magnetic field lines orient in the same manner as in **Hurst** when a current is flowing through the wordline (i.e. according to the right hand rule or around the wordline, just as shown in Fig. 16 of **Hurst**) and therefore perpendicular to the shown direction **in the absence of current**, just as in Applicant’s disclosure. If the magnetic field in the keeper 120 aligns as shown in Fig. 16 of **Hurst**, “[u]pon application of current in the wordline 120” (column 7, lines 9-10) it is clear that the alignment is **not** as shown in it the absence of the current, which means it behaves as in the

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instant application and would result in a “substantially perpendicular” orientation to that orientation while current is flowing through the word line.

See *In re Swinhart*, 169 USPQ 226,229 (CCPA 1971) (where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that subject matter shown to be in the prior art does not possess the characteristics relied on) and *In re Fitzgerald*, 205 USPQ 594 (CCPA 1980) (the burden of proof can be shifted to the applicant to show that subject matter of the prior art does not possess the characteristic relied on whether the rejection is based on inherency under 35 USC 102 or obviousness under 35 USC 103).

Regarding claims 37 and 39, **Hurst** shows the keeper structure is formed in a U shape which encases the read/write conductors (i.e. the word line) (Figs. 13 and 16).

### ***Claim Rejections - 35 USC § 103***

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 34, 37, and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Hurst** considered with **Chen**.

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If it is thought that the structure in **Hurst** does not inherently provide the magnetization or easy axis of the stabilizing (keeper) structure to be substantially perpendicular to the easy axis of the sense layer, then this may be a difference.

**Chen** teaches the benefits of stabilizing the ends of the sense layer substantially perpendicular to the easy axis of the sense layer, by using either soft or hard ferromagnetic material which is ferromagnetically coupled, i.e. ferromagnetically exchange coupled to the ends of both the sense layer and the reference layer by virtue of direct contact therewith. (See column 4, lines 10-11, 41-44, and 58-63; column 6, lines 5-10. Compare to Applicant's specification, page 8, line 26 to page 9, line 4 and page 9, lines 18-24.)

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a soft or hard ferromagnetic material to stabilize the magnetization of the edge regions of the sense layer in **Hurst** in a direction perpendicular to the easy axis of the sense layer and to use a hard ferromagnetic material as taught by **Chen** for the beneficial reasons indicated therein, because stabilized end regions improves the magnetic memory over one which does not have stabilized end regions, as taught in both **Hurst** and **Chen**.

Alternatively, the prior art of **Chen**, as explained above, discloses each of the claimed features except for indicating that the keeper structure is in a U shape which encases the read/write conductors (i.e. the word line).

It would have been obvious for one of ordinary skill in the art, at the time of the invention to modify the structure of **Chen** to form the U-shape of **Hurst**, for the reasons indicated in **Hurst**, at least at col. 7, lines 6-15, to more effectively concentrate the magnetic field above the



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word line than could be obtained by a keeper structure no formed in a U shape and encasing the word line.

9. Claim 42 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Chen** in view of US 5,587,943 (**Torok et al.**).

The prior art of **Chen**, as explained above, discloses each of the claimed features except for indicating if the memory cells have square outer dimensions.

**Torok** shows that a typical magnetic memory cell has square outer dimensions as a result of the intersection between the wordline and bitline which is square. (See Figs. 9, 11, 12A, 12B, 13, and 14.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to form the **Chen** memory cell in a square shape as taught by **Torok** because **Torok** teaches that this is standard shape for a memory cell. Moreover, one of ordinary skill would be motivated to use the square shape formed by the intersection between the wordline and bitline in order to form an array of memory cells on a single chip, as shown in **Torok**.

#### ***Response to Arguments***

10. Applicant's arguments with respect to claims 23-33 have been considered but are moot in view of the new claims presented and the cancellation of claims 23-33.

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*Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.



Erik Kielin

November 19, 2002